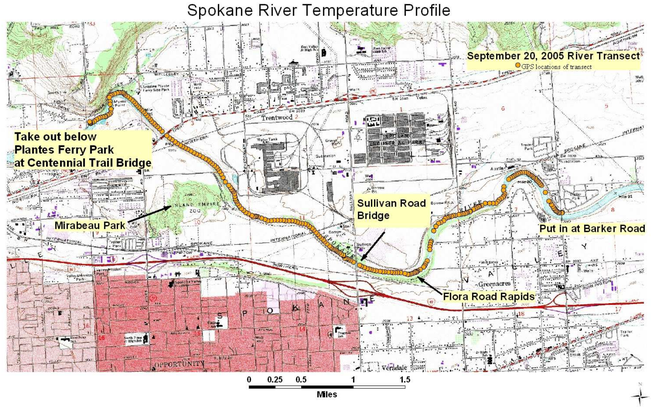
September 20, 2005 Temperature Profile of the Spokane River
From the Barker Road Bridge to the Centennial Trail Bridge

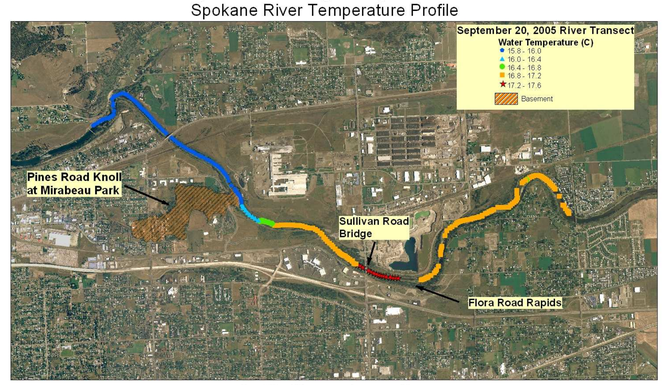
Figure 1
Location Map
Spokane River Temperature Profile

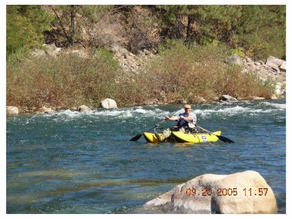


A profile of river temperatures was gathered from the Spokane River on September 20, 2005. This dataset was obtained using instrumentation programmed to take temperature, depth, and location measurements on frequent intervals while floating between Barker Road Bridge and Centennial Trail Bridge below Plantes Ferry Park in Spokane Valley, Washington.

While the results of this profile confirm the Spokane River is recharged by the Spokane Valley Rathdrum Prairie Aquifer beginning near the location of Sullivan Road, data suggests the most significant volume of discharge of aquifer water to the river occurs near the Pines Road Knoll at Mirabeau Park.

Figure 2
Temperature Readings Every 30 Seconds
Spokane River Temperature Profile





Data on temperature and water depth were gathered using a Solinst® Levelogger® Model 3001 towed in a protective plastic housing behind a single-seat inflatable pontoon craft. Location data was gathered and logged for time using a Trimble® GeoXM™ using TerraSync™ and Geoexplorer® CE software.

Temperature and depth data were gathered by dragging the Levelogger® in a protective housing behind the pontoon craft as it was piloted downstream. Generally, the craft was kept near the center of the stream. The GPS unit was carried aboard the pontoon craft. The housing assembly was attached to a rope approximately eight feet long, gathering temperature and depth measurements every six seconds. The GPS unit recorded position every 30 seconds.

Effectively, two temperature profiles were collected: An upper profile beginning at Barker Road and ending as the data logger housing was caught between boulders in the Flora Road rapids; and a lower profile beginning at the Flora Road rapids ending approximately 40 feet upstream of the Centennial Trail Bridge near Plantes Ferry Park.

Figure 5
Temperature Profile-Upper Section
Barker Rd. to Flora Rapids

The initial profile, between Barker Road and Flora Road Rapids (collected between 11:15 and 12:04) shows a relatively constant temperature profile in Figure 5. Temperature varied only 0.14° C over the float period. This relatively high temperature suggests this stretch is not receiving colder aquifer water.

Following resumption of the float, from 12:53 to 14:11, river temperature along the profile decreased 1.45°C. Figure 6 illustrates this abrupt drop. In the vicinity of the Sullivan Road Bridge, river temperatures cool because of discharge of colder aquifer water from springs which can be observed at low flow conditions. Just upstream from the Pines Road Knoll basement outcrop, a dramatic temperature drop of over one degree Centigrade occurs within the span of less than one-half mile.

Beyond Mirabeau Park to Plantes Ferry Park, temperatures return to relatively steady conditions, yet still above the 10-11°C ambient aquifer temperature.

Figure 6
Temperature Profile-Lower Section
Flora Rapids to Plantes Ferry Park

Figure 8
High Cooling Rate Locations
Spokane River Temperature Profile

In the vicinity of the Pines Road Knoll at Mirabeau Park, a significant change in temperature is observed. Here, the cooling rate is greater than two standard deviations above the mean rate of temperature change observed along the traverse (Figure 8).
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Flux estimation

A simple mass balance calculation suggests that the temperature mixing model closely approximates direct flow measurements of groundwater discharge.

Q(Barker) * T(Barker) + Q(ground water) * T(ground water)=Q(Plantes Ferry)*T(Plantes Ferry)

Where:

Q(Barker) =(our closest flow measurement to the gaining reach starting at Sullivan) = 1390 cfs
T(Barker) = 17.2 C
Q(ground water) = X (the unknown)
T(ground water) = 11 C
Q(Plantes Ferry) = (1390 + X) cfs
T(Plantes Ferry) (as measured at Plantes Ferry Park) = 15.84 C
1390(17.2) + X(11) = (1390 + X)15.84
23908 + X(11) = 22018 + 15.84(X)
1890 = 4.8(X)
X = Groundwater discharge = 394 cfs

This simple mass balance calculation suggests that approximately 394 cfs of groundwater was discharging to the Spokane River on September 20, 2005 between Barker Road and Plantes Ferry Park.

As a part of the ongoing SVRPA study, two seepage runs along the Spokane River have been conducted by the USGS (one in September 2004 and again in August of 2005). Their miscellaneous discharge measurements collected at Barker Road and at Centennial Trail Bridge below Plantes Ferry Park show an average increase of 399 cfs between the two sites for low-flow, late summer conditions.

Spokane River Temperature Profile, Barker Road to Plantes Ferry Park, September, 2005, Gregory, Guy and Covert, John, Washington Dept of Ecology, Water Resources Program Publication No. 06-11-005
Available at http://www.ecy.wa.gov/pubs.shtm

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